

REMARKS

Claims 1-7 are pending. The Examiner has rejected claim 1 under 35 U.S.C. §102(b) as being anticipated by Sakakibara et al. (U.S. Patent No. 6,225,548), or in the alternative, obvious under 35 U.S.C. §103(a) over Sakakibara. In addition, claims 2-7 are rejected under 35 U.S.C. §103(a) as being obvious over Sakakibara in view either Kudman (U.S. Patent No. 3,737,345), Suzuki (U.S. Patent No. U.S. 2002/0026856) or Sharp (U.S. Patent No. 6,169,245). Applicants respectfully request reconsideration of the pending claims in view of the preceding amendments and the following remarks.

Independent Claim 1

Claim 1 is directed to a thermoelectric nanogranular material with an enhanced Seebeck coefficient that includes a processed thermoelectric nanogranular material, wherein the material includes particles having a grain size d , characterized by the relationship $mfp/2 < d < 5mfp$, and

wherein mfp is the phonon-limited mean free path of an equivalent bulk thermoelectric material prior to processing a bulk thermoelectric material into the processed thermoelectric nanogranular material having a grain size d . [emphasis added]

Contrary to the Examiner's assertion (Office Action, page 3), Sakakibara does not teach or suggest the above recited feature of claim 1.

Rather, Sakakibara discloses a thermoelectric semiconductor compound having a first thermoelectric semiconductor in the form of a matrix, and a second thermoelectric semiconductor in the form of particles dispersed in the matrix. (Sakakibara, col. 1, lines 7-9; col. 2, lines 61-65). An average diameter of the dispersed particles complies with the formula $A < D < B$, where A is the mean

free path of a carrier in a single crystal of the second thermoelectric semiconductor and B is the mean free path of a long wavelength phonon in the single crystal of the second thermoelectric semiconductor. (Sakakibara, col. 2, lines 66-col. 3, line 5). The Examiner contends that the grain size of the particles in the processed thermoelectric nanogranular material of claim 1, which is characterized by $mfp/2 < d < 5mfp$, where mfp is the “phonon-limited mean free path of an equivalent bulk thermoelectric material prior to processing a bulk thermoelectric material” is taught by, or in the alternative, obvious in light of the above recited formula in Sakakibara. Applicants respectfully disagree and submit that the Examiner has erroneously expanded the scope and breadth of what is disclosed by Sakakibara.

As known by one of ordinary skill in the art, the mean free path of a particle is the average distance traveled between successive collisions with other particles. (Random House Unabridged Dictionary, 2006; McGraw-Hill Dictionary of Scientific and Technical Terms Sixth Edition). Therefore, the mean free path of any particle is clearly dependent on the type of particle and it's interaction with the material in which it is traveling through. Consequently, a range of diameters defined by the mean free path of a carrier in a single crystal and the mean free path of a long wavelength phonon of the single crystal is different from, and yields a different result than, a range defined by $mfp/2 < d < 5mfp$, where mfp is the “phonon-limited mean free path of an equivalent bulk thermoelectric material prior to processing a bulk thermoelectric material.” To the extent the Examiner intends to take Official Notice that one of ordinary skill in the art recognizes that the grain size of a particle within the range characterized by $mfp/2 < d < 5mfp$, where mfp is the “phonon-limited mean free path of an equivalent bulk thermoelectric material prior to processing a bulk thermoelectric material” is the same as an average diameter of a particle that complies with the

formula A<D<B, where A is the mean free path of a carrier in a single crystal of the second thermoelectric semiconductor and B is the mean free path of a long wavelength phonon in the single crystal of the second thermoelectric semiconductor, Applicants seasonably request support for the taking of Official Notice, as provided by 37 CFR 1.104(d)(2) and MPEP § 2144.04.

In addition, claim 1 recites that the *mfp* is the mean free path of an equivalent bulk thermoelectric material prior to processing. The Examiner states that this feature is shown in Sakakibara by the use of the phrase “second semiconductor.” (Office Action, page 3). Specifically, the Examiner states that “This requirement is designated as the second semiconductor material constraint, showing this is before the processing takes place, as shown in Figure 2, where mixing is the first step.” *Id.* Applicants respectfully submit that the Examiner has misconstrued the teachings of this reference. Sakakibara identifies a compound having a first semiconductor and a second semiconductor, with a common element therebetween. The example set forth in Sakakibara defines the first semiconductor as AgBiTe₂ and the second semiconductor as AgTe where the common element is Te. (Sakakibara, col. 3, lines 6-11). Moreover, Figure 2 illustrates “a process for producing the thermoelectric semiconductor compound 3 having the foregoing chemical structure,” not the process of producing the second semiconductor as claimed by the Examiner. (Sakakibara, col. 3, lines 32-34) [emphasis added]. There is simply no teaching or suggestion that the mean free path of the second semiconductor in Sakakibara is determined prior to processing or that the nomenclature of second semiconductor is indicative of a stage in the mixing process. Indeed, it is clear from the foregoing that the “second semiconductor” is intended to represent one of the two semiconductor compositions combined to create the thermoelectric semiconductor compound (i.e.,

compound 3). Therefore, for at least the reasons set forth above, independent claim 1 and dependent claims 2-7 are patentable over the cited references and in condition for allowance.

Dependent Claims 2-7

As set forth above, the Sakakibara reference fails to disclose all of the features recited in independent claim 1. The addition of Kudman, Suzuki or Sharp fail to cure these deficiencies. Therefore, for at least the reasons discussed above, the rejection of claims 2-7, which depend from independent claim 1, should be withdrawn.

CONCLUSION

Reconsideration and allowance are respectfully requested. In view of the above, each of the presently pending claims in this application is believed to be in condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 18-0013, under Order No. 65899-0726 from which the undersigned is authorized to draw. To the extent necessary, a petition for extension of time under 37 C.F.R. § 1.136 is hereby made, the fee for which should be charged to such deposit account number.

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